

**THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:**

1. A de-burring apparatus, for removing burrs from interior surfaces of a slotted metal liner,
5 said apparatus comprising:

(a) a torch carrier body having a front end and a rear end;

(b) a torch head connected to the torch carrier body at the front end thereof, said
torch head having a longitudinal axis and a circumferential lateral surface, said
torch head having formed therewithin:

10 b.1 a fuel plenum, for receiving a fuel mixture comprising a combustion
gas and a primary oxidizing gas;

b.2 an auxiliary plenum, for receiving and conveying an auxiliary
oxidizing gas from a source of auxiliary oxidizing gas;

15 b.3 a plurality of fuel channels, each fuel channel having an outer end and an
inner end, and each fuel channel at its inner end being in fluid
communication with the fuel plenum; and

20 b.4 a plurality of nozzle ports, each nozzle port extending inward from the
circumferential lateral surface of the torch head and having an inner wall
surface, and each nozzle port being in fluid communication with a
corresponding one of the fuel channels; and

(c) a plurality of torch nozzles, each nozzle having an outer end, an inner end, and a
side surface, an inner end, and each nozzle having a fuel passage extending
through the nozzle between said inner and outer ends;

said apparatus being characterized by:

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- (d) each nozzle being retainingly installed within a corresponding nozzle port and defining an interstitial space between the side surface of the nozzle and the inner wall surface of the nozzle port, said interstitial space having an outer end in proximity to the outer end of the nozzle;
- 5 (e) the outer end of each nozzle extending close to or beyond the circumferential surface of the torch head;
- (f) the inner end of each nozzle being sealingly engaged with the fuel channel associated with the corresponding nozzle port, such that the outer end of the fuel passage of each nozzle is in fluid communication with the fuel plenum; and
- 10 (g) each interstitial space being in fluid communication with the auxiliary plenum, and intercepting the circumferential surface of the torch head, such that auxiliary oxidizing gas can flow from the auxiliary plenum into the interstitial spaces and exit at the outer end thereof.
- 15 2. The de-burring apparatus of Claim 1, further comprising centralizer means, for substantially aligning the longitudinal axis of the torch head with the longitudinal axis of the slotted liner.
- 20 3. The de-burring apparatus of Claim 2 wherein the centralizer means comprises a plurality of rub bars disposed circumferentially around the torch carrier body, each rub bar being rotatably mounted to a bracket hingingly mounted to the torch carrier body, and each bracket having biasing means for urging the associated rub bar radially outward.
- 25 4. The de-burring apparatus of Claim 1, further comprising a flame shield rearward of the nozzles.
5. The de-burring apparatus of Claim 1, further comprising means for regulating the pressure of a fuel mixture flowing to the nozzles.

6. The de-burring apparatus of Claim 1, further comprising means for regulating the pressure of an auxiliary oxidizing gas flowing to the interstitial spaces.

7. The de-burring apparatus of Claim 1, further comprising torch head cooling means.

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8. The de-burring apparatus of Claim 7 wherein the torch head defines one or more coolant circulation chambers for receiving a circulating coolant fluid.

9. The de-burring apparatus of Claim 1 wherein the nozzle ports are substantially uniformly spaced circumferentially around the torch head.

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10. The de-burring apparatus of Claim 1 wherein at least one torch nozzle is radially oriented relative to the longitudinal axis of the torch head.

11. The de-burring apparatus of Claim 1 wherein at least one torch nozzle is oriented substantially perpendicularly to the longitudinal axis of the torch head.

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12. The de-burring apparatus of Claim 1 wherein at least one nozzle is canted toward the front end of the torch head.

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13. The de-burring apparatus of Claim 1 wherein at least one torch nozzle is oriented obliquely relative to the longitudinal axis of the torch head.

14. The de-burring apparatus of Claim 1 wherein the fuel passage of at least one nozzle has a constriction so as to accelerate a fuel mixture exiting therefrom.

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15. The de-burring apparatus of Claim 1 wherein at least one torch nozzle is a MIG tip.

16. The de-burring apparatus of Claim 1 wherein at least a portion of the interstitial space is of annular cross-section.

17. The de-burring apparatus of Claim 1, further comprising motive means for moving the torch head relative to the slotted liner.

18. The de-burring apparatus of Claim 17 wherein the motive means is adapted to hold the slotted liner longitudinally stationary and move the torch head through the slotted liner.

19. The de-burring apparatus of Claim 17 wherein the motive means is adapted to hold the torch head longitudinally stationary and move the slotted liner over the torch head.

20. The de-burring apparatus of Claim 17, further comprising torch head speed control means, for controlling the torch head's rate of travel relative to the slotted liner.

21. The de-burring apparatus of Claim 1, further comprising temperature-monitoring means, for monitoring the temperature of the slotted liner in the vicinity of the nozzles.

22. The de-burring apparatus of Claim 20, further comprising temperature-monitoring means, for monitoring the temperature of the slotted liner in the vicinity of the nozzles, and wherein the torch head speed control means is adapted to adjust the torch head speed according to variations in liner temperature as measured by the temperature-monitoring means.

23. A method of removing burrs from interior surfaces of a slotted metal liner, said method comprising the steps of:

- (a) providing a torch head having one or more torch nozzles;
- (b) delivering a fuel mixture comprising a combustion gas and a primary oxidizing gas to the one or more torch nozzles;

- (c) igniting the fuel mixture exiting the one or more torch nozzles, thus creating one or more torch flames;
- (d) introducing an auxiliary oxidizing gas in the immediate vicinity of each torch flame so as to raise the flame temperature to a level sufficient to substantially incinerate metal burrs present on the interior surface of the slotted liner; and
- (e) passing the torch head through the slotted liner at an appropriate speed such that the torch flames are directed toward the interior surface of the slotted liner so as to substantially incinerate the metal burrs.

24. A method of removing burrs from interior surfaces of a slotted metal liner, said method comprising the steps of:

- (a) introducing a fuel mixture comprising a combustion gas and a primary oxidizing gas into the fuel plenum of the torch head of a de-burring apparatus according to Claim 1, such that the fuel mixture flows into the fuel passages of the torch nozzles of the torch head;
- (b) igniting the fuel mixture exiting the fuel passages of the torch nozzles to create torch flames;
- (c) introducing an auxiliary oxidizing gas into the auxiliary plenum of the torch head, such that the auxiliary oxidizing gas flows out of the interstitial spaces around the torch nozzles;
- (d) regulating the respective flowing pressures of the fuel mixture and auxiliary oxidizing gas so that the torch flames are of a temperature sufficient to substantially incinerate metal burrs present on the interior surface of the slotted liner; and
- (e) passing the torch head through the slotted liner at an appropriate speed such that the torch flames are directed toward the interior surface of the slotted liner so as to substantially incinerate the metal burrs.

25. The de-burring method of Claim 23 or 24 wherein the step of passing the torch head through the slotted liner is effected by holding the liner longitudinally stationary and moving the torch head through the liner.

5 26. The de-burring method of Claim 23 or 24 wherein the step of passing the torch head through the slotted liner is effected by holding the torch head stationary and passing the liner over the torch head.

10 27. The de-burring method of Claim 23 or 24 further comprising the step of rotating the liner relative to the torch head.

15 28. The de-burring method of Claim 23 or 24 wherein the torch head defines one or more coolant circulation chambers, and further comprising the step of circulating a coolant fluid through the coolant circulation chambers.

29. The de-burring method of Claim 28 wherein the coolant fluid is a liquid coolant.

30. The de-burring method of Claim 29 wherein the liquid coolant comprises water.

20 31. The de-burring method of Claim 29 wherein the liquid coolant comprises ethylene glycol.

32. The de-burring method of Claim 28 wherein the coolant fluid comprises a coolant gas.

25 33. The de-burring method of Claim 32 wherein the coolant gas comprises air.

34. The de-burring method of Claim 23 or 24 wherein the combustion gas is selected from the group consisting of MAPP gas, acetylene, propane, and natural gas.

5 35. The de-burring method of Claim 23 or 24 wherein the fuel mixture is substantially stoichiometrically balanced.

36. The de-burring method of Claim 23 or 24 wherein the primary oxidizing gas comprises substantially pure oxygen.

10 37. The de-burring method of Claim 23 or 24 wherein the auxiliary oxidizing gas comprises substantially pure oxygen.

38. The de-burring method of Claim 23 or 24 wherein the auxiliary oxidizing gas comprises air.